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Title: An in-situ ZnS(Ag) UCN detector: conceptual studies

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UCNTau, collaboration

Intended for: discussion with potential external collaborators
Web

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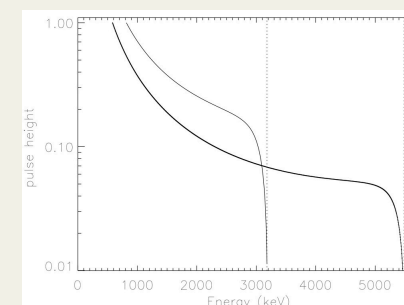
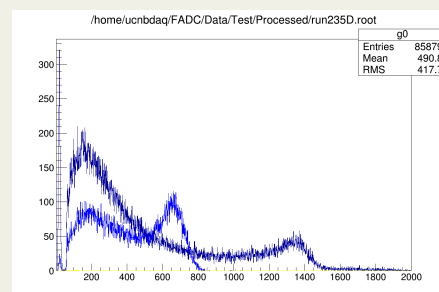
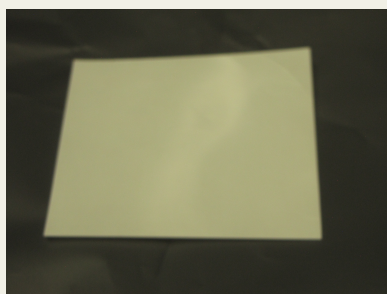
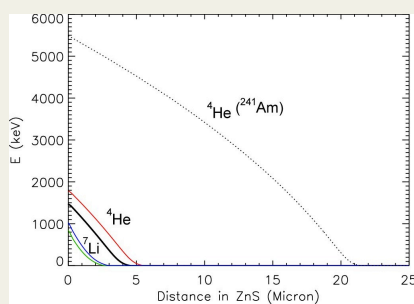
An in-situ ZnS (Ag) UCN detector

conceptual studies

Z. Wang, C. L. Morris for the Lifetime Experiment

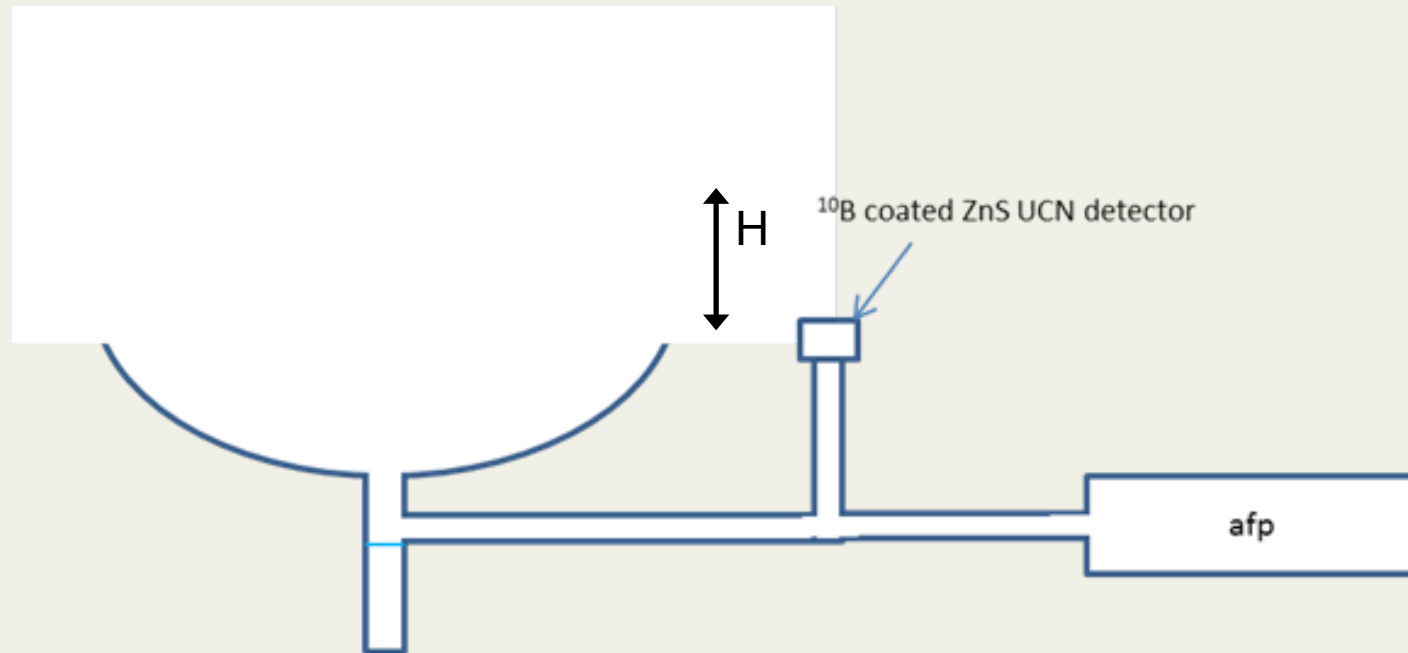
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Updated: Mar 21, 2014

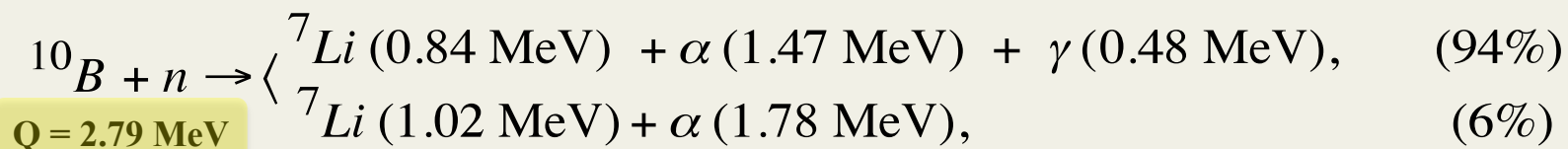
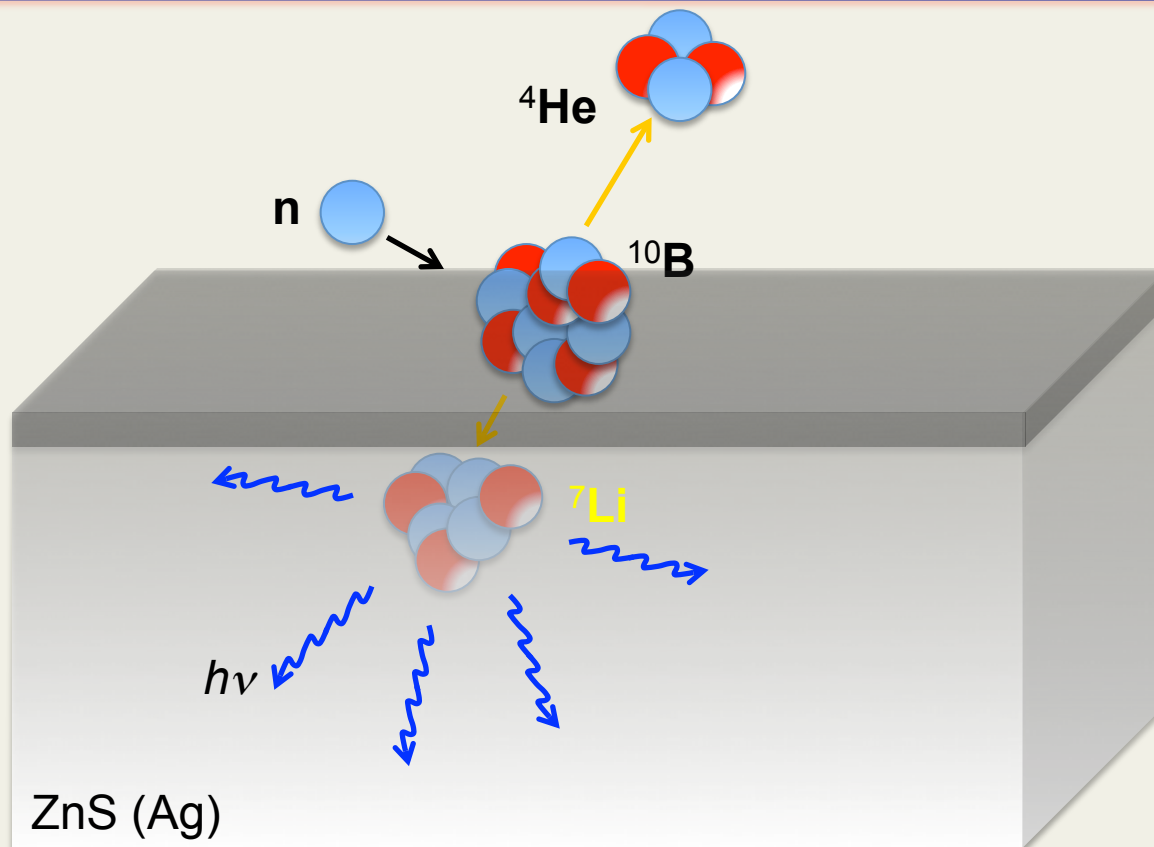


Proposed measurement

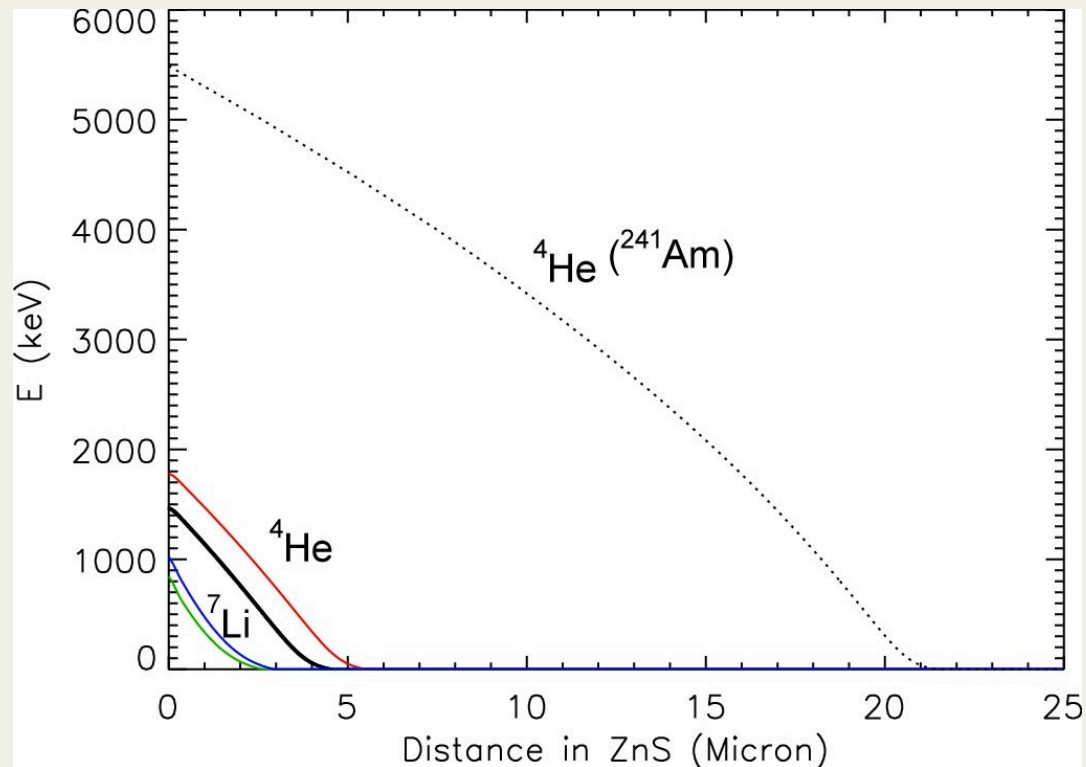
- No material barriers in-between UCN's and detector
- Real time
- UCN Spectroscopy (Adjustable in height)



Detection principle ($n \gg \alpha$, ${}^7\text{Li} \gg h\nu \gg e^-$)

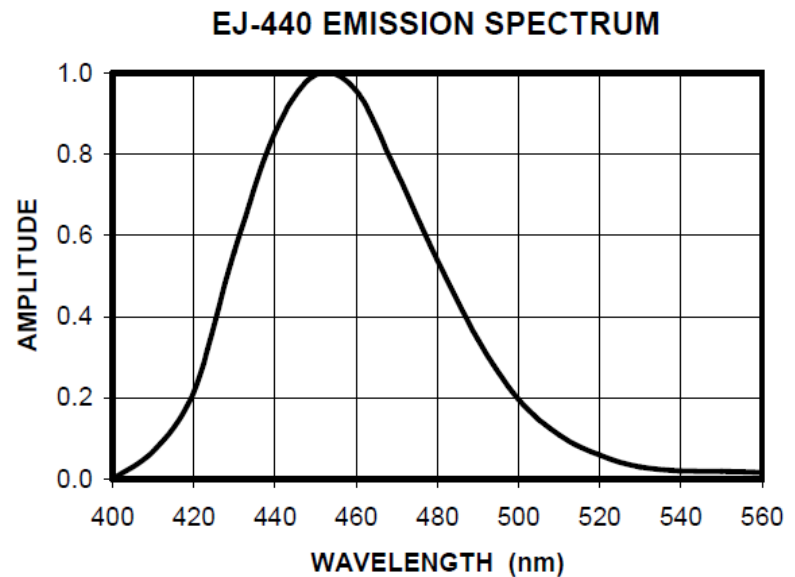


Charge propagation



ZnS (Ag) / Light yield

- Proven use for MeV charge particle detection
- Inorganic scintillator
- Eljen
 - 120 μm thick substrate
 - 16 μm average particle size
 - 4.09 g/cc
- Other suppliers

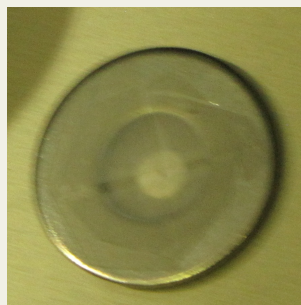
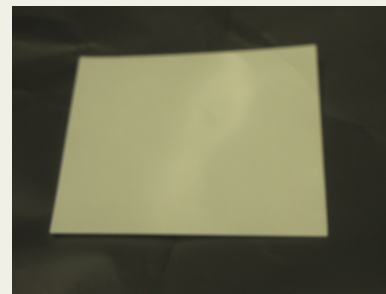
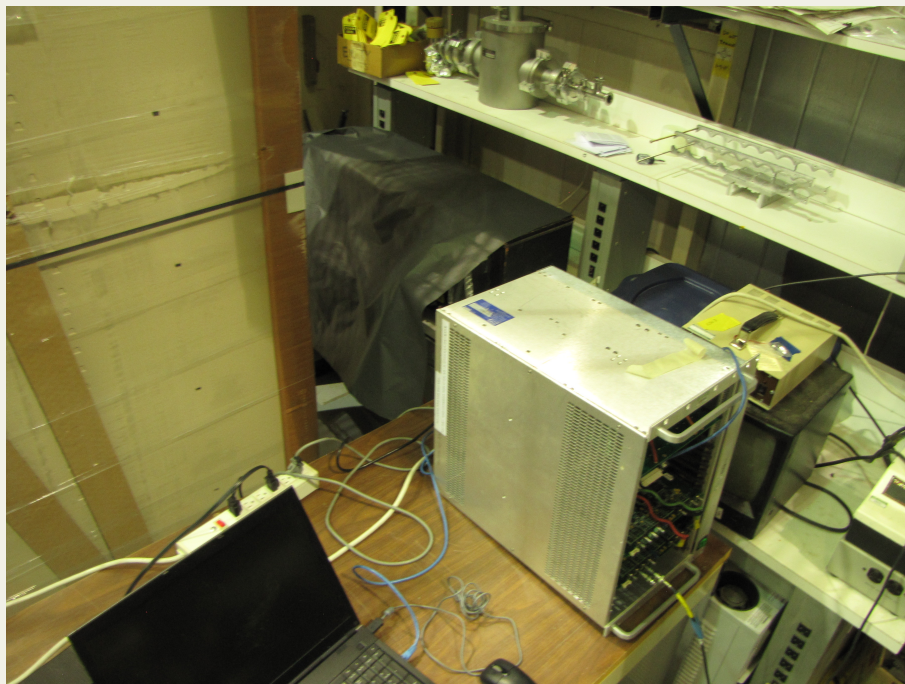


Component Testing

(for detector design)

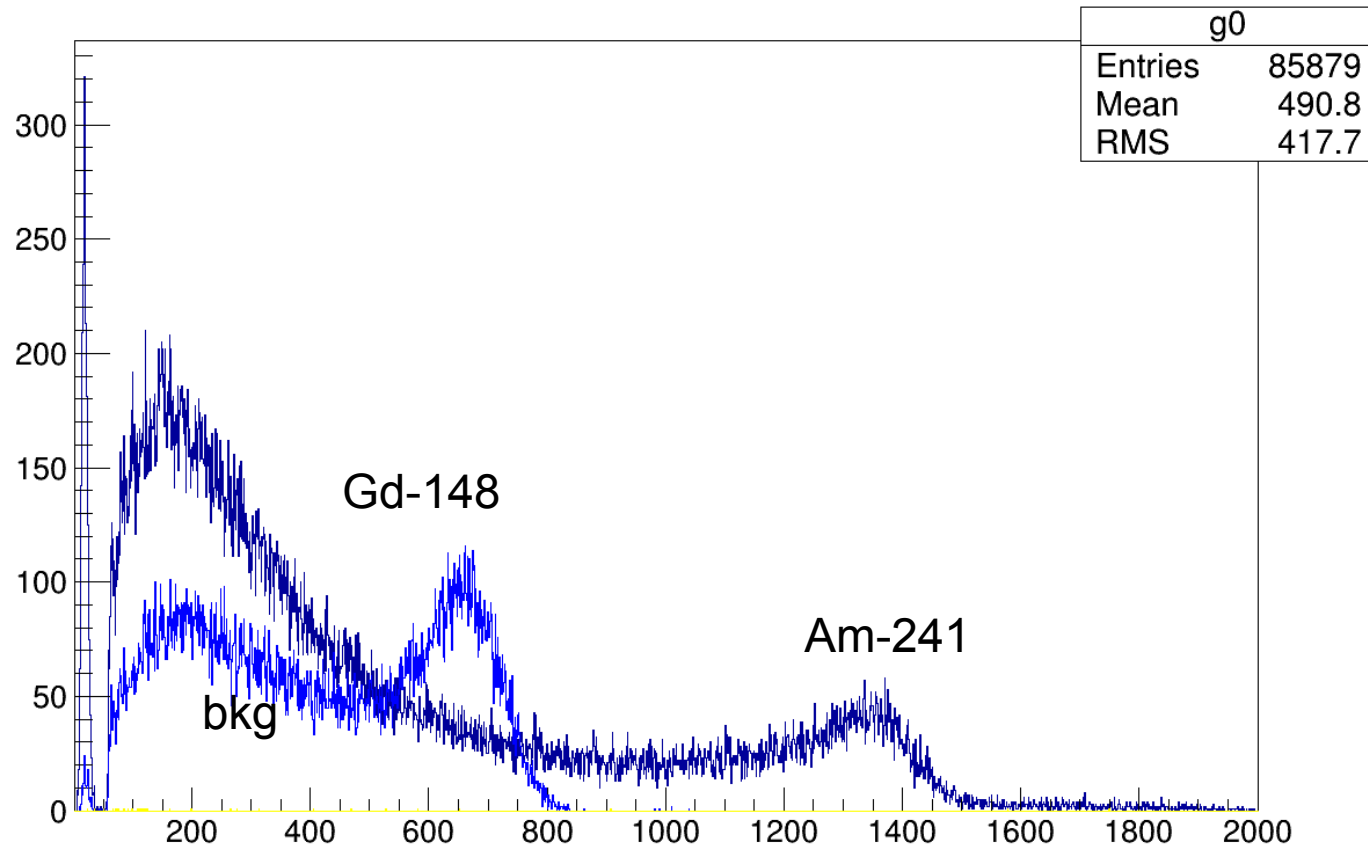
- ZnS (Ag) Thickness
- Sensitivity to alpha's w/different energies;
- Noise/background
- $h\nu \rightarrow e$ detector selection

Testing setup

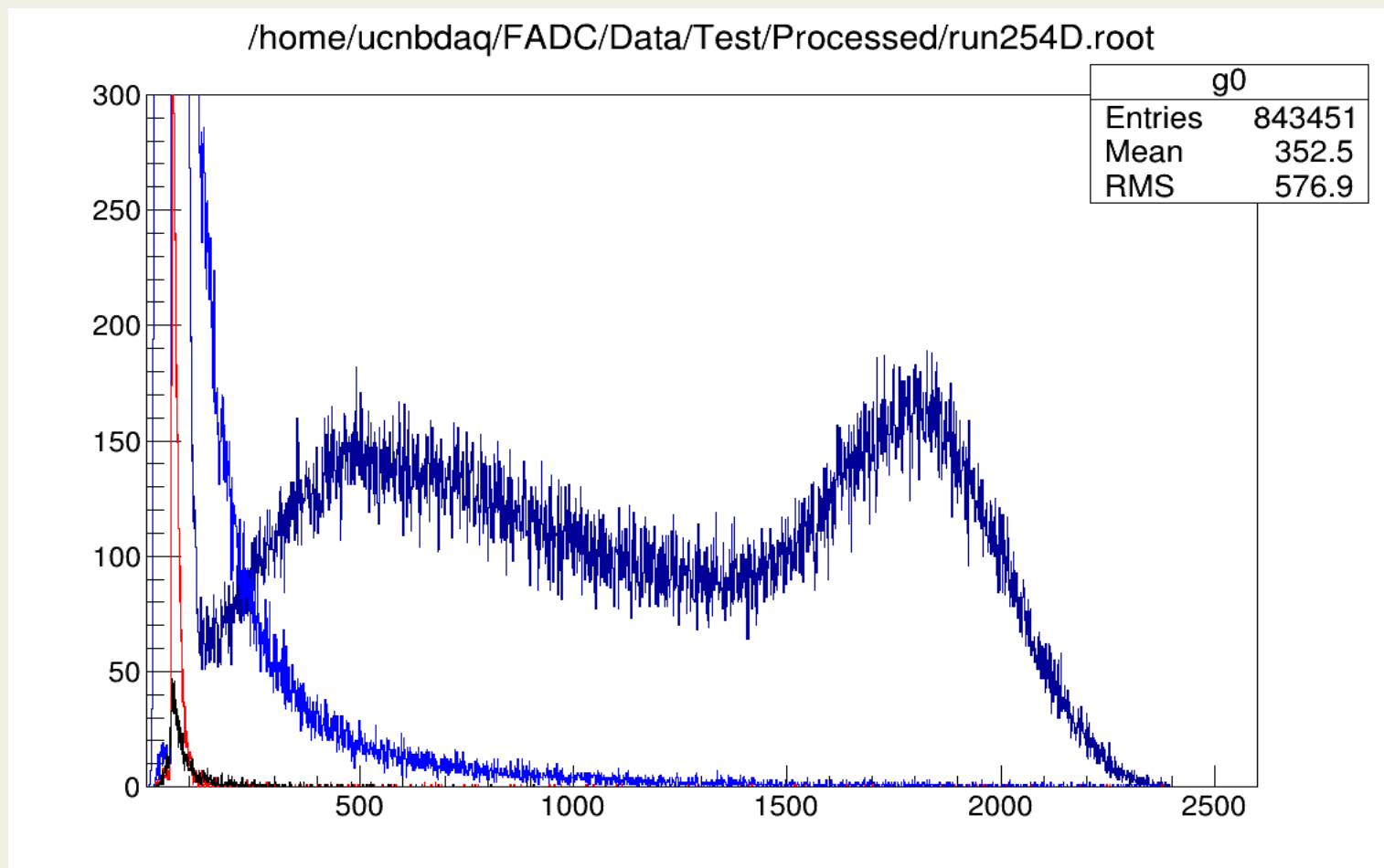


α -response (on-contact)

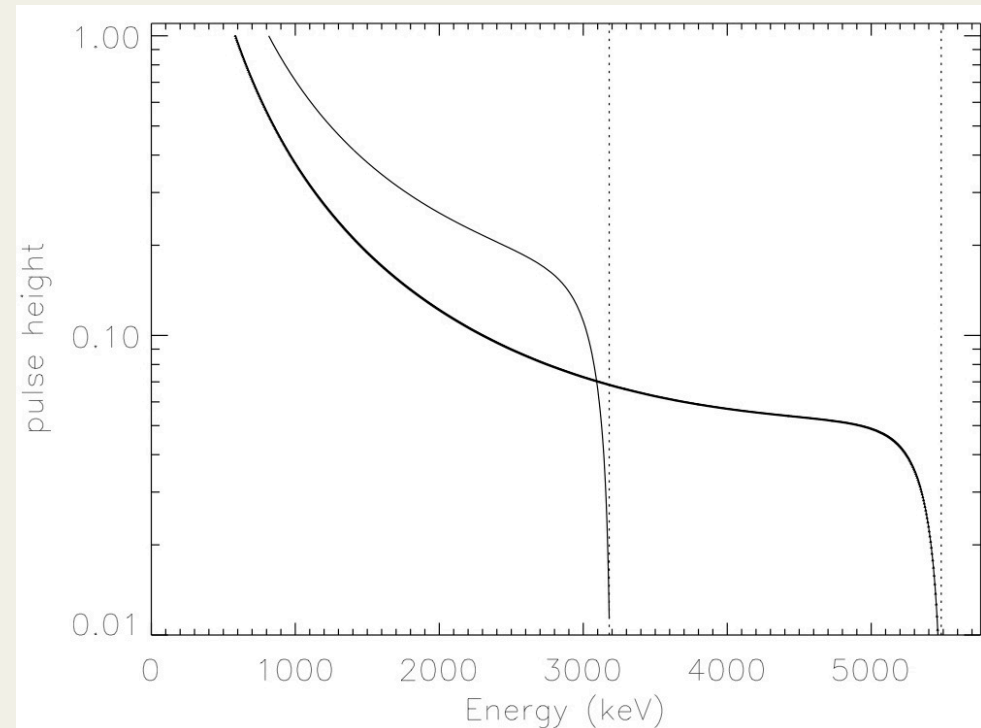
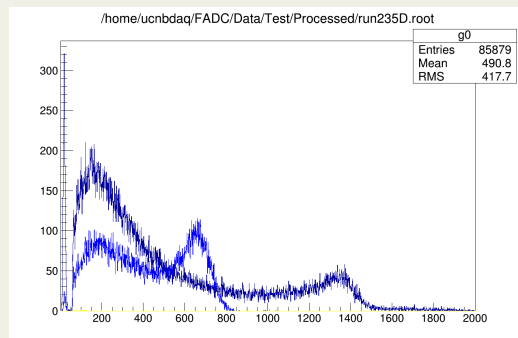
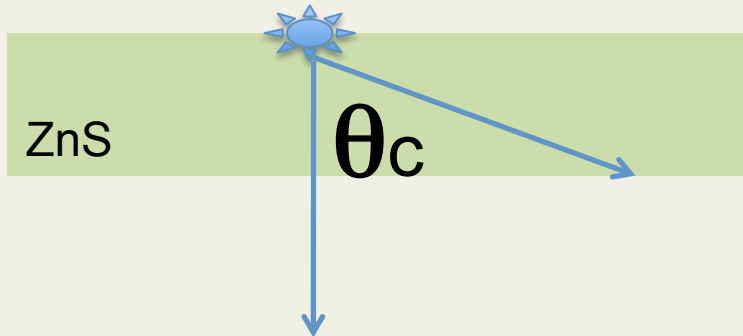
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Background

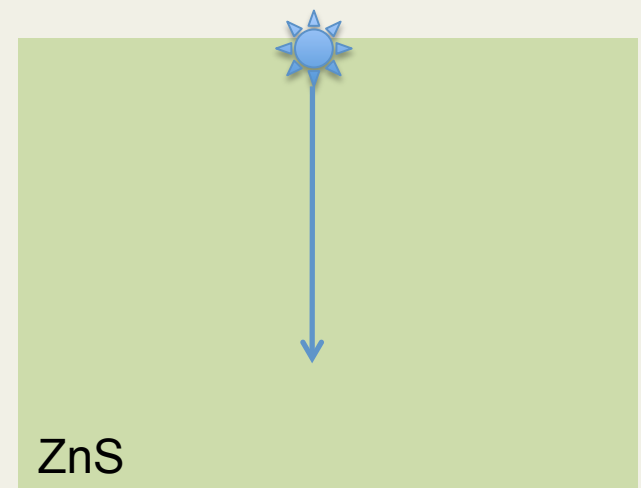
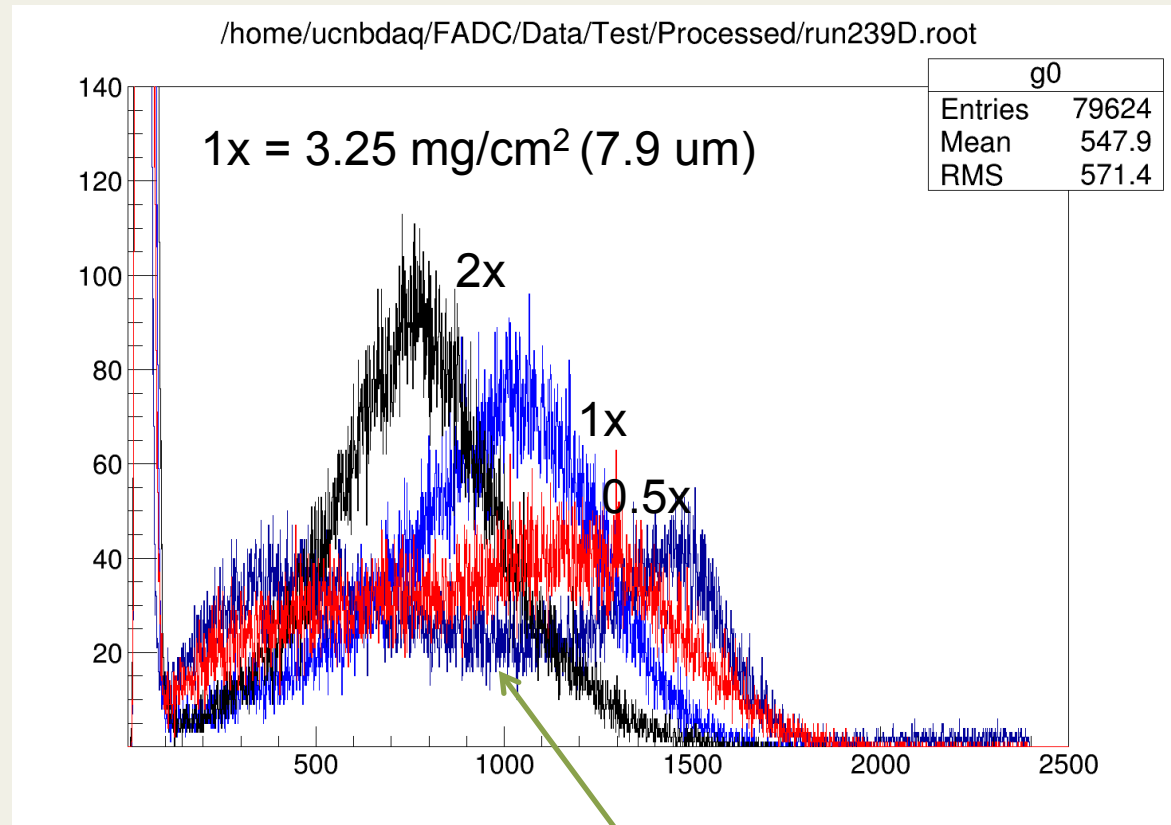


PSD interpretation/Thin-Slab model



Straggling \rightarrow broadening (convolution function)

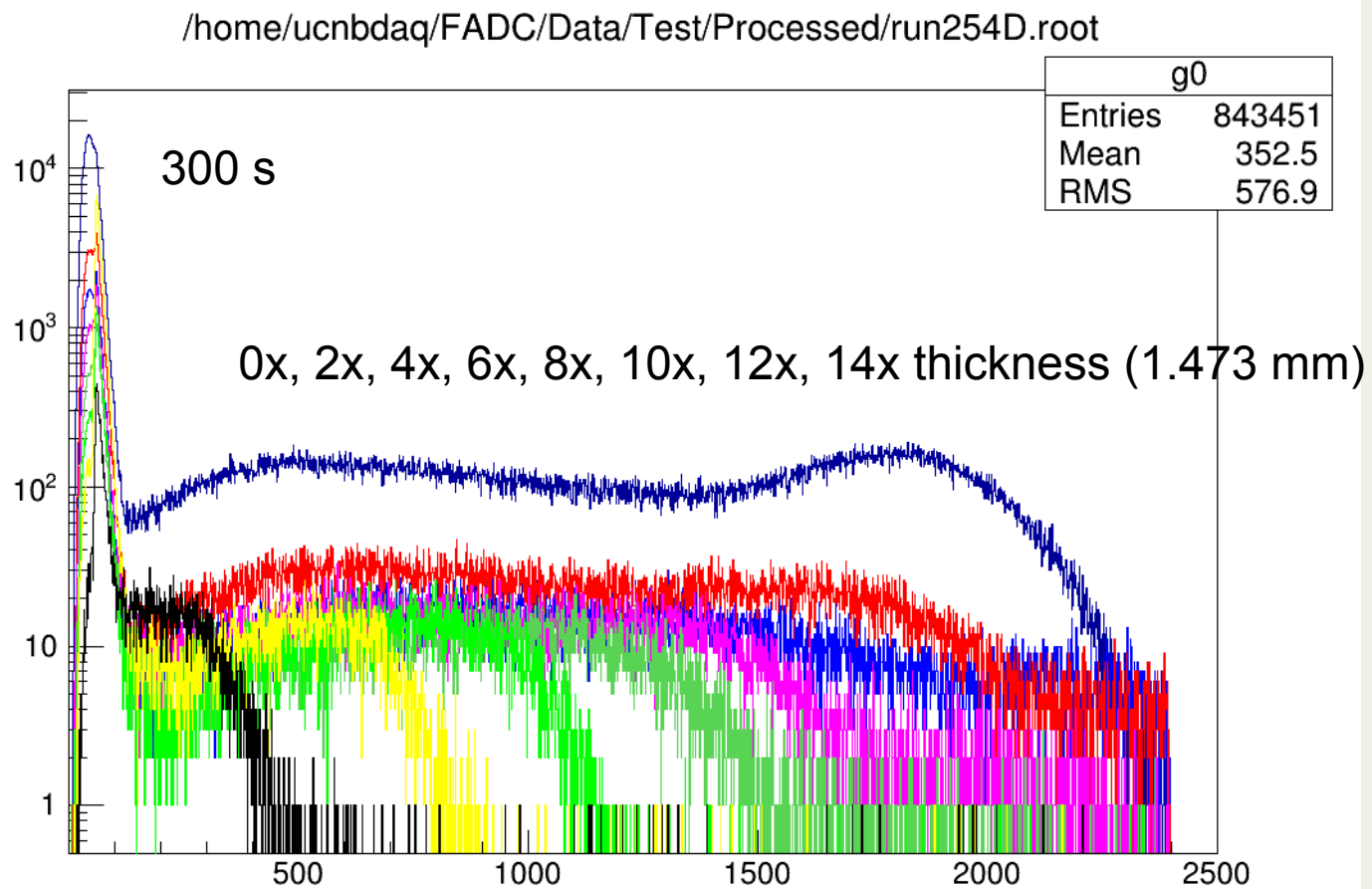
ZnS thickness scan (Thick slab)



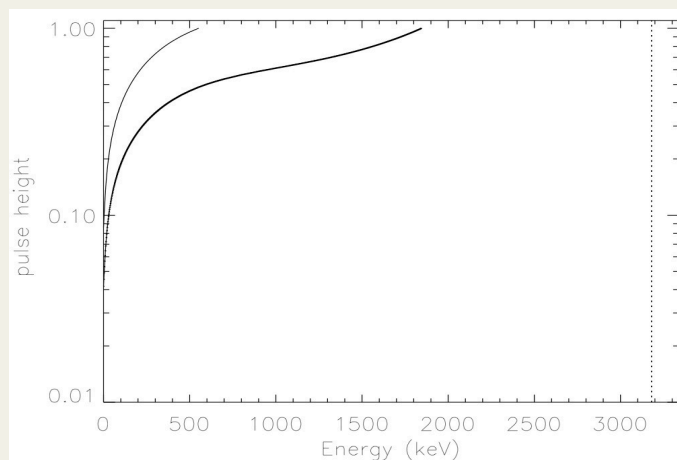
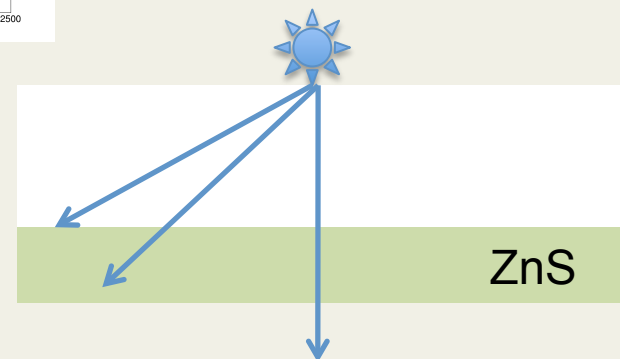
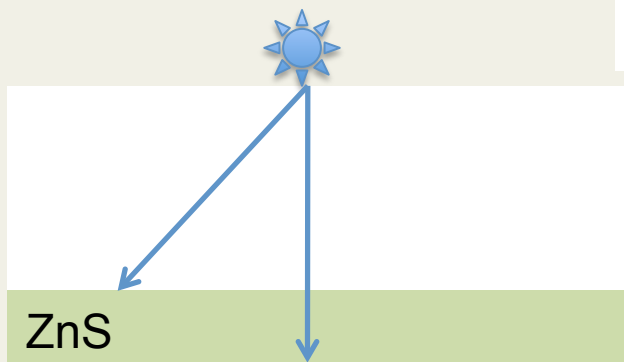
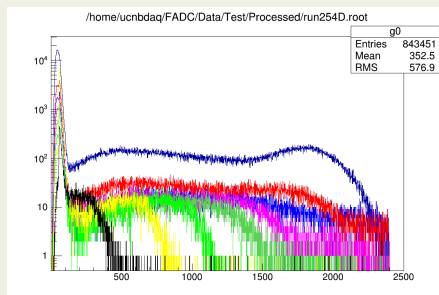
Alpha energy scan (II)

Air

ZnS



PSD interpretation



Summary

- ZnS(Ag) substrates characterized through alpha-particle measurements
 - Am-241, Gd-148 sources;
 - 3" PMT
 - ZnS different thickness, manufacturers
- PSD can be explained by charge particle stopping + straggling
- Prototype fabrication underway
 - Detector design (3" diameter)
 - B-10 coating (~ 100 nm thick)